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**ASSIGNMENT: PHYSIOLOGY ASSIGNMENT**

1. **Long term regulation of mean arterial blood pressure**

**Mean arterial blood pressure** is the measure of stress on the blood vessels. In each cardiac cycle arterial blood pressure fluctuates between diastolic and systolic pressure. However, the body behaves from day to day as if it regulated the mean arterial blood pressure, which is the average between diastolic and systolic pressures. Such regulation is achieved by interdependent adjustments of only 3 parameters: Heart rate (HR), ventricular stroke volume (SV) and total peripheral vascular resistance (TPVR). These are related as follows: HR - SV = Cardiac Output (CO); CO - TPVR = Mean Arterial Blood Pressure. The regulatory system includes stretch-sensitive sensors, central nervous integrators/evaluators and neuro-humoral effector mechanisms. Central nervous integration and evaluation of incoming signals occurs mostly in the pons/medulla regions of the midbrain. The most important effector mechanisms are the parasympathetic and sympathetic divisions of the autonomic nervous system, the renin-angiotensin system and vasopressin. Short-term regulation of arterial blood pressure is dominated by the baroreceptor mechanism, whereby pressure is sensed by both cardio-pulmonary nerve endings and stretch-sensitive cells in renal afferent arterioles.

**High-pressure baroreceptors at the carotid sinus and aortic arch are stretch receptors that sense changes in arterial pressure**

Corneille Heymans was the first to demonstrate that pressure receptors—called **baroreceptors**—are located in arteries and are part of a neural feedback mechanism that regulates mean arterial pressure. He found that injection of epinephrine—also known as adrenaline—into a dog raises blood pressure and, later, lowers heart rate. Heymans hypothesized that increased blood pressure stimulates arterial sensors, which send a neural signal to the brain, and that the brain in turn transmits a neural signal to the heart, resulting in bradycardia.

To demonstrate that the posited feedback loop did not depend on the blood-borne traffic of chemicals between the periphery and the CNS, Heymans cross-perfused two dogs, so that only nerves connected the head of the dog to the rest of the animal’s body. The dog’s head received its blood flow from a second animal. (Today, one would use a heart-lung machine to perfuse the head of the first dog.) Heymans found that the vagus nerve carried both the upward and the downward traffic for the reflex arc and that agents carried in the blood played no role. He used a similar approach to demonstrate the role of the peripheral chemoreceptors in the control of respiration.

1. **Pulmonary circulation:** s the circulation which carries blood from the right ventricle low in oxygen and high in carbon dioxide to the lungs for oxygen then the oxygenated blood to be taken back to the left atrium. The right side of the heart serves the pulmonary circuit receives blood that has circulate through the body unloaded oxygen and nutrients and picked up a load of carbon dioxide and other wastes, it pumps the blood to the pulmonary trunk which divides into left and right pulmonary arteries then they transport blood back to the lungs where oxygen is picked up and the oxygen rich blood flow by the pulmonary vein to the left side of the heart.
2. **Circle of willis:** it is also known as the cerebral arterial circle of willis. It is a pentagon shaped circle of vessels on the ventral surface the brain. It is an important anastomose at the base of the brain between four arteries (two vertebral and two carotid arteries) that supplies the brain. The arterial circle is formed sequentially in an anterior to posterior direction by the following arteries;

* Anterior communicating artery
* Anterior cerebral artery
* Internal carotid artery
* Posterior communicating artery
* Posterior cerebral artery
* Basilar artery

1. **Coronary circulation**: is the circulation that deals with the blood vessels of the heart wall. The arterial supply is divided into two,

The left coronary artery which passes under the left auricle and it divides into two branches.

The anterior interventricular artery passes down the anterior interventricular sulcus towards the apex, it gives off smaller branches to the interventricular septum and the anterior wall of both ventricules, it is also called the left anterior descending artery.

The circumflex artery: it continues the left side of the heart and supplies the left atrium and posterior wall of left ventricle.

The right coronary artery supplies the right atrium and continue along the coronary sulcus under the right auricle. It gives off two branches,

The marginal artery: supplies the lateral aspect of right atrium and ventricle.

The posterior interventricular artery: supplies the posterior wall of both ventricles.

1. **Splanchnic circulation**: The splanchnic circulation comprises the gastric, small intestinal, colonic, pancreatic, hepatic, and splenic circulations. They are arranged in parallel and fed by the celiac artery and the superior and inferior mesenteric arteries.

The splanchnic circulation is composed of the blood flow originating from the celiac, superior mesenteric, and inferior mesenteric arteries and is distributed to all abdominal viscera. The splanchnic circulation can act as a site of regulation of distribution of cardiac output and also as a blood reservoir. Multiple regulatory pathways are involved in the distribution of the splanchnic circulation.

1. **Cutaneous circulation**: The cutaneous circulation, particularly in the hands and feet, has been subjected to extensive investigation, using a variety of techniques.

The results from these studies show that humoral and neural influences which operate elsewhere in the body control skin blood flow, the latter being mediated‐ through the sympathetic nervous system.

Apart from its nutritive function, the circulation in skin is involved in the control of systemic blood pressure and, probably more important, plays an essential role in man's thermal homeostasis.

1. **Cardiovascular adjustment that occurs during exercise:** The integrated response to severe exercise involves fourfold to fivefold increases in cardiac output, which are due primarily to increases in cardiac rate and to a lesser extent to augmentation of stroke volume. The increase in stroke volume is partly due to an increase in end-diastolic cardiac size and secondarily due to a reduction in end-systolic cardiac size. The full role of the Frank-Starling mechanism is masked by the tachycardia. The reduction in end-systolic dimensions can be related to increased contractility, mediated by beta adrenergic stimulation. Beta adrenergic blockade prevents the inotropic response, the decrease in end-systolic dimensions, and approximately 50% of the tachycardia of exercise. The enhanced cardiac output is distributed preferentially to the exercising muscles including the heart. Blood flow to the heart increases fourfold to fivefold as well, mainly reflecting the augmented metabolic requirements of the myocardium due to near maximal increases in cardiac rate and contractility. Blood flow to the inactive viscera (e.g., kidney and gastrointestinal tract) is maintained during severe exercise in the normal dog. It is suggested that local autoregulatory mechanisms are responsible for maintained visceral flow in the face of neural and hormonal autonomic drive, which acts to constrict renal and mesenteric vessels and to reduce blood flow. However, in the presence of circulatory impairment, where oxygen delivery to the exercising muscles is impaired as occurs to complete heart block where normal heart rate increases during exercise are prevented, or in congestive right heart failure, where normal stroke volume increases during exercise are impaired, or in the presence of severe anemia, where oxygen-carrying capacity of the blood is limited, visceral blood flows are reduced drastically and blood is diverted to the exercising musculature.